Stat 567:Statistical Reliability
Eighteen Class (October 30, 1996)

Proportional Hazard Model and Proportional Odds Model

Class Objectives:

- Learn the definition and properties of the proportional hazard model
- Learn the definition and properties of the proportional odds model
- Preview where we are going in reliability data regression
- Learn how to use JMP to fit the proportional hazards model

Homework Assignments:

- Reproduce the JMP output in "Fitting the proportional hazards model using SAS's JMP"

Class Outline and Main Points:

Proportional Hazards Model

- Definition of the proportional hazards model
  - In terms of hazards functions
  - Origins of the name
  - Baseline hazard
  - Interpretation
- A result useful for diagnostics plots
  - The proportional hazards model is invariant under monotone functions of time
- Survivor function formulation of the proportional hazards model
- Risk ratios
  - Definition
  - Interpretation
- Theorem:
  - A model that is both an accelerated life model and a proportional hazards model must have a Weibull baseline distribution function. The converse is also true.
    - Derivation
  - When the baseline is Weibull both characterization of the model are useful
    - Diagnostic plots developed for either model can be used
- Diagnostic plots for grouped data

- Plots of the log integrated hazards versus time at the different stresses should be vertically shifted copies of each other, and the horizontal scale can be transformed with a monotone transfomation, e.g., log t, for a tidier plot
  - Weibull baseline leads to parallel Weibull plots
- Fitting the proportional hazards model using SAS's JMP.

Proportional Odds Model

- Definition of proportional odds model
  - In terms of survivor functions
  - Interpretation
- Relationships between ratios of hazard functions and ratios of survivor functions
  - As time goes from zero to infinity there is a diminishing influence of the stress on the hazard function
    - Maybe the stress only affects some items in the populations and as these items fail the remaining components are unaffected by the stress
    - Importance on understanding the physical assumptions that a model implicitly makes
- A result useful for diagnostics plots
  - The proportional odds model is invariant under monotone functions of time
- Diagnostics plots for grouped data
  - Plots at the different stresses of the log (distribution/survival) versus time should be vertically shifted copies of each other, and the horizontal scale can be transformed, e.g., log t, for a tidier plot.

(Brief Discussion of Other Life Data Regression Models)

Study Questions

- Can you think of situations where each of the following models should apply?
  - Accelerated life
  - Proportional hazards
  - Proportional odds
- Why do we frequently start with a Weibull baseline when doing reliability data regression?
- Suppose that we find that the Weibull plots at the different stresses are not parallel. Can the data satisfy a proportional hazards model?
- If a model is both accelerated life and proportional hazards, what is its baseline distribution?

SAS JMP files (Mac) of classroom examples and homework

- Data on the failure stresses of single carbon fiber. (Table 4.1, Page 81 of your textbook)

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Find out how to download a JMP file

Do you have something to tell me?